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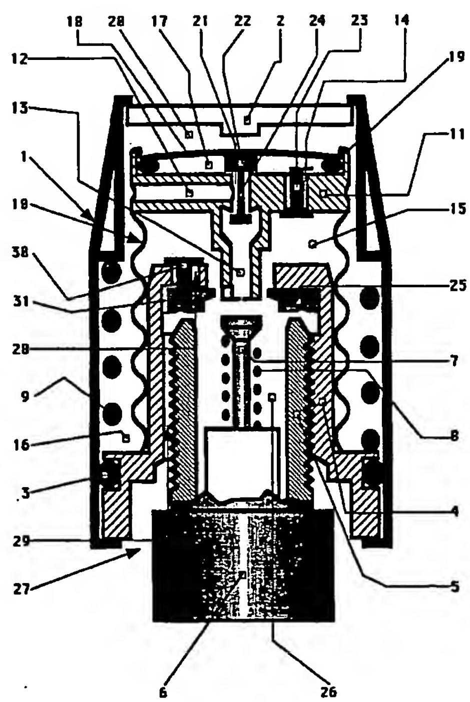
(54) Device capable of signalling the inflating condition in the tires

(57) A device capable of signalling the inflating condition in the tires comprises: an external envelope (1) rotating with a threaded body (4) which can be screwed on a jointing tube (5) of an inflating valve (6); a plunger (11) fitted with a housing (17) closed by a deformable lamina (18); a bellows (10) separating a first chamber (20) located over the plunger (11) from a second chamber (15) defined under the plunger (11); the lamina (18) presents a downward bending when the atmospheric pressure acts on the housing (17) and the tire pressure acts on the first chamber (20) having a value higher than a pre-established value; a third chamber (16) connected to the first chamber (20) is delimited by the external wall of the bellows (10) and the internal wall of the envelope (1); a fourth chamber (26) is found inside the tube (5), the chamber (26) being separated from the second chamber (15) when the rod of the plunger (11) seals a gasket (25); ducts (12,14,21) connect the chambers (16,20) to the chamber (15) and the atmosphere (27) when the tire pressure falls below a pre-established value.

Fig.1



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Description

BACKGROUND OF THE INVENTION

The present invention relates to a device capable of signalling the inflating condition in the tires; the device comprises an external covering capable of rotating together with a threaded body used for screwing the device on the body of a standard inflating valve, a chamber defined inside the threaded body, an element sensible to the pressure existing in the chamber, a member which can be deformed by the pressure considering the temperature and a system capable of signalling the position of the deformable member.

STAND OF THE TECHNIQUE

US-A- 5,694,969 relates to a device for inflating a tire of a wheel. A pressure relief tire valve for inflating a tire wheel assembly has a tire inflation valve body having a chamber therein with openings through the top and bottom ends thereof and having a relief opening formed in the tire valve body. An inflation valve having a spring loaded central core to allow to pass inward is located in the tire valve body adjacent the tire inflation valve body top end for inflating the tire there through. An over pressure valve is located in the tire valve body for releasing air from the tire when the air pressure in the tire exceeds a predetermined level. The over pressure valve has a valve seat and valve element biased against the valve element by a compression for maintaining the valve element in a closed position until the predetermined air pressure is reached in the tire and to allow the valve element to open to release air through the valve body relief opening when the air pressure in the tire and to allow the valve element to open to release air through the valve body relief opening when the air pressure in the tire exceeds the predetermined pressure. A heat variable bellows supports the compression spring and is responsive to changes in temperature of the air in the tire so that the over pressure valve can prevent over inflating the tire as well as loss of tire pressure upon an increase of air pressure in the tire from an increase in temperature of the air in the tire.

This and other documents of prior art do not regard a device for signalling the inflating state in the tires, but an assembly limiting pressure in the case of an excessive increase of the air tube temperature.

AIMS AND FEATURES OF THE INVENTION

The present invention, as claimed, solves the problem of creating a device capable of signalling the inflating condition in the tires. The results obtained by means of the present invention mainly consist in the fact that the function of controlling and automatically preventing the escape of air from the tire continues to be effected by the self-closing core of the inflating valve also in presence of the device, which is, therefore, used only for signalling if the tire pressure is correct or not, without introducing the risk of the tire being deflated in case the same device presents an escape.

The advantages offered by the invention consist in the fact that the tire pressure is indicated considering at least one threshold value; above said thresh old value the device signals the normal inflating state of the tire, while the same device signals the non correct inflating state when the tire pressure is below the same threshold value or another pre-established value lower than the previous threshold value; a temperature-sensing element allows to consider the temperature for defining the threshold values while a signalling system indicates if the tire inflating condition is correct or not.

BRIEF DESCRIPTION OF THE DRAWINGS

Other advantages, features and aims of the invention may be more readily understood by referring to the accompanying drawings, which concern a preferred embodiment, in which:

Fig.1 represents the device before its tightening on the valve;
Fig.2 represents the device after its tightening;
Fig.3 shows the device during the loading phase;
Fig.4 represents the device after the loading phase;
Fig.5 demonstrates the behaviour of the device when the tire pressure has reached a value below a pre-established threshold;
Fig.6 represents the device after the decrease of the tire pressure below the threshold value.

DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

The device according to the invention consists of an external envelope 1, the upper wall 2 of which is preferably transparent; the envelope 1 rotates with a threaded body 4 which can be screwed on the threaded jointing tube 5 of the inflating valve 6; the valve 6 presents a self-closing valve core 7 stressed by a spring 8. The self-closing valve core 7 automatically prevents the escape of the air from the tire though allowing its inflating.

The external envelope 1 can slide axially with respect to the threaded body 4, being maintained in a stable limit stop with respect to the same body 4 by means of a spring 9; the sealing between the envelope 1 and the threaded body 4 is secured by a toroidal gasket 3. A bellows 10 connects the threaded body 4 to a plunger 11, where three internal ducts 12, 13, 14 are bored. The bellows 10 allows the frictionless axial sliding of the plunger 11 inside the device; in addition, said bellows 10 separates two chambers 15, 20; the chamber 15 is found under the plunger 11 and inside the bellows 10, while the chamber 20 is located over the plunger 11 being connected to a chamber 16 with continuity; the

chamber 16 is located outside the bellows 10. In this way, the plunger 11 can be axially moved by the differences of pressure which take place between the chamber 15 (lower) and the chamber 20 (upper).

In a not shown embodiment, the function of the bellows 10, consisting in separating the two chambers 15, 20 located, respectively, under and over the plunger 11, is carried out by a sliding gasket which causes friction when the plunger 11 is moved.

The upper part of the plunger 11 presents a housing 17 closed by a lamina 18 which can be deformed; a toroidal gasket 19 assures the sealing between the inner part of the housing 17 closed by the lamina 18 and the chamber 20 which is located between the upper wall 2 and the lamina 18, the chamber 20 being directly connected to the chamber 16. A channel 21 joints the housing 17 with the duct 13 bored inside the rod of the plunger 11; the rod presents two portions with different external diameters. The lamina 18 controls the channel 21 by means of a bistable valve 22 fitted with a double closing de vice, the valve 22 being operated by the same lamina 18 presenting a first position of stability when a first section of the closing device closes the connection between the housing 17 and the channel 21 allowing the connection between the duct 13 and the channel 21, and a second position of stability when a second section of the closing device closes the connection between the duct 13 and the channel 21 allowing the connection between the housing 17 and the channel 21.

The duct 14 connects the internal part of the housing 17 to the chamber 15 located under the plunger 11 and inside the bellows 10, the duct 14 being con trolled by a self-closing valve 23 allowing the air passage from the housing 17 into the chamber 15, but not vice versa.

The duct 12 connects the chambers 16 (located in the external part of the bellows 10) and 20 (situated over the plunger 11) to the channel 21 where the rod 24 of the bistable valve 22 with the double closing device is inserted.

The envelope 1 transmits a torque to the threaded body 4, i.e. a rotation: in practice, when the device is screwed on the valve 6; the valve 6 is screwed on the envelope 1 with the fingers in order to transmit the torque which causes the rotation of the threaded body 4 for clamping the gasket 25 used for sealing the body of the valve 6 with respect to the device.

A chamber 26 is defined inside the jointing tube 5 of the inflating valve 6, the chamber 26 being separated from the chamber 15 only if the plunger 11 is found in the bottom limit stop so that the section of its rod having the larger diameter clamps the internal edge of the gasket 25.

When the gasket 25 is completely clamped, the chamber 15 located inside the bellows 10 is connected to the atmosphere 27 through a duct 28, a groove 31 and a channel 29. The duct 28 is controlled by a self closing valve 30, which is in opening position for allowing the air flow from the chamber 15 to the channel 21 and the channel 29, and consequently to the atmosphere 27, only if the gasket 25 has been completely clamped; in the case of insufficient clamping of the gasket 25 the valve 30 is not open, therefore, the passage of the air from the chamber 15 to the channel 21 and the channel 29, and consequently to the atmosphere 27, is prevented; this occurs even in the case of incomplete clamping of the gasket 25, provided that the gasket 25 is brought into contact with the threaded jointing tube 5.

The device shown in Fig.1 has not yet been clamped on the valve 5, 6; in this case the attempt of loading the device causes no effect, therefore, the device automatically unloads, since, on one hand, the chamber 26, the ducts 13, 21, 12, the chamber 16 and the chamber 20, located over the plunger 11, do not maintain the tire pressure because of the air escape which takes place between the gasket 25, insufficiently clamped, and the valve body 5, with consequent blow-by and direct discharging to the atmosphere 27 through the channel 29, and, on the other hand, the discharge to the atmosphere of the chamber 15 located under the plunger 11 cannot occur (during the transient loading, the chamber 15 is subject to the air tube pressure before being isolated from the chamber 26 at the instant when the portion of the rod of the plunger 11 having the external larger diameter clamps the internal edge of the gasket 25): in fact, the valve 30 remains closed since it opens only because of the clamping compression of the gasket 25 and because of the thrust applied on the same valve 30 by the pressure existing in the chamber 15.

In addition, if the clamping of the gasket 25 on the threaded jointing tube 5 is incomplete, so that the blow-by towards the channel 29 and groove 31 occurs, the air will also tend to flow back to the chamber 15 through the groove 31 be cause of the losses of pressure due to the back flow through the channel 29. The right equilibrium between the losses of pressure in said channels 28, 29 can assure the unloading of the device for insufficient clamping of the gasket 25, even in the case of absence of the self-closing valve 30. For this reason, it is possible to immediately understand that the device is insufficiently tight, anyhow, situations of risk of deflating of the tire for insufficient tightening do not occur.

Fig.2 shows the device after its tightening; after the complete screwing of the device on the valve 5, 6 of the tire, and therefore, obtaining the adequate tightening of the gasket 25 through screwing of the body 4 on the valve 5, 6, the device is ready to work. In the condition of Fig.2 the device exactly works as a cap of a traditional tire inflating valve, i.e. the device does not carry out any function, but it is only used for protecting the valve. The tire valve 5, 6 is closed by the self-closing valve core 7, therefore, the air tube is neither connected to the chamber 26, nor to the atmosphere.

Usually, the lamina 18 is bent upwards; this bending is maintained until the pressure in the chamber 20 has reached a sufficiently high value with respect to the value of the pressure existing in the housing 17 (i.e. the

atmospheric pressure, since the housing 17 is connected to the atmosphere, as it will more readily understood by referring to following description), therefore, when the pressure value is sufficiently high, the bending is directed downwards.
In fact, the bending of the lamina 18 depends on the difference between the pressure in the chamber 20, which successively will be connected to the tire air tube, and the pressure in the housing 17, which will be connected to the atmosphere. If this difference of pressure, which advantageously can be corrected considering the temperature value in the case of balanced measure effected by a bimetal 18, is sufficiently high, the bimetal 18 will bend down wards, for reaching a stable downward bent position shown in Figs 3, 4 representing the functioning of the device, otherwise the bimetal 18 will maintain its upward bent configuration.

The subsequent operation consists in loading the device; this operation takes place (Fig.3) by means of a manual external axial thrust P which causes the axial motion of the external envelope 1 with respect to the threaded body 4 by exceeding the thrust of the spring 9. Because of the thrust P applied on the external body of the device (external envelope 1, wall 2) also the plunger 11 is moved downwards by the thrust P transmitted to the lamina 18 through the upper wall 2; owing to the thrust P, the lamina 18 is bent downwards just as it would happen if the pressure in the chamber 20 was sufficiently higher than the pressure in the housing 17. This is the loading operation, when the device is set at work, which would happen if the difference between the pressure in the chamber 20, on one hand, and the pressure in the housing 17 and the chamber 15 on the other hand, was sufficiently high. It is remarkable that, in this first phase of the transient loading, the difference between the pressure in the chamber 20, on one hand, and the pressure in the chamber 15 and the housing 17 (connected to each other through the duct 14) on the other hand, has not yet happened and stabilised, therefore, the bending of the lamina 18 and the downward motion of the plunger 11 occur only because of the mechanical thrust P.
This new geometrical configuration of the lamina 18 also causes the motion of the valve 22 fitted with a double closing device towards the first position of stability; therefore, the valve 22 connects the duct 13 to the duct 12 and the chambers 16, 20, and disconnects the jointing between the channel 21 and the housing 17. It is to remember that the chamber 20 extends from the upper surface of the lamina 18 to the chamber 16 external to the bellows 10 with continuity.
In addition, owing to the same thrust P the plunger 11 is moved downwards; therefore, the lower end of the rod of the plunger (inside which the duct 13 is bored) pushes downwards the end of the self-closing valve core 7, which opens to allow the air inside the tube to fill the chamber 26 defined inside the jointing tube 5 of the inflating valve 6.

The gasket 25 is also capable of sealing the rod of the plunger 11 by means of its internal lip only when the plunger 11, the rod of which presents two diameters, is moved towards the low limit stop shown in Fig.3 (loading position). Consequently, if at the beginning of the opening of the self-closing valve core 7, during the downward motion of the plunger 11, the air coming out of the tube fills the chamber 26, the chamber 15, the duct 28, the channel 29, the groove 31 (and the ducts 12, 13, the channel 21, and the chambers 16, 20, since those cavities are connected to each other), in the moment when the plunger 11 has reached its low limit stop, and, therefore, the sealing between the rod of the plunger 11 and the gasket 25 is allowed, also the separation of the chamber 26 defined inside the jointing tube 5 of the inflating valve 6 takes place from the chamber 15 located under the plunger 11 and inside the bellows 10. It is remarkable that the sealing on the rod of the plunger 11, which is necessary for insulating the chambers 26 and 15 when the plunger 11 is found at the low limit stop, can also be obtained by means of a gasket different from the gasket 25, for example, a toroidal gasket integral with the threaded body 4: the solution consisting in integrating the sealing in the same gasket 25 allows the reduction of the axial dimensions.
Once this condition is reached, the pressure existing in the air tube is established in the chamber 26, the ducts 12, 13, and the chambers 16 and 20; vice versa, the atmospheric pressure is established in the chamber 15 and the housing 17 and in the ducts 14, 28, 29 and the groove 31. Two cavities have, therefore, been separated, the first cavity 20 is found over the plunger 11, while the second cavity 15 is located under the plunger 11; this separation is due to the gasket 25 on one hand (sealing on the rod of the plunger 11) and, on the other hand, the bellows 10 (sealing on the plunger 11). When the external thrust P is removed, if the difference between the pressure in the chamber 20 and the pressure in the housing 17 (i.e. between the tube and the atmosphere) is sufficiently high (we remember that the chamber 15, through the internal duct 14, is also connected to the housing 17, which, in this way, is subject to the atmospheric pressure), the lamina 18 will maintain the down ward bent configuration due to the thrust P, even when the same thrust P has been removed, and consequently the connection of the duct 13 to the housing 17 through the channel 21 will be closed, but the connection of the duct 13 to the duct 12 (and, therefore, of the duct 13 to the chambers 16, 20) through the same channel 21 will be open, thanks to the first position of stability reached by the bistable valve 22 fitted with a double closing device.
After the releasing of the thrust P, the spring 9 and the air pressure in the chambers 16, 20 move the external envelope 1 back upwards which reaches its original position shown in Fig.4. In this configuration, if the air pressure (air tube pressure) existing in the chamber 20 (eventually corrected considering the temperature value in the case of a balanced measure effected by a bimetal

18), is such as to exert a stress on the upper surface of the lamina 18, the stress being sufficient to maintain the lamina 18 bent downwards (in fact, the atmospheric pressure exists in the housing 17); said stress also holds the plunger 11 fastened in its low limit stop, since, owing to difference in the active sections, said stress easily exceeds the thrust due to the air tube pressure on the rod of the plunger 11 and the thrust of the spring 8.

In such a way, the rod of the plunger 11 maintains the self-closing valve core 7 open for assuring the continuous connection between the air tube and the measuring system 18 through both the chamber 26 and the chamber 20, where the air tube pressure exists. Each air escape is obviously prevented by the sealing due to the gaskets 25, 19, 3 and the bellows 10. Consequently, as shown in Fig.4, as long as the tire pressure (eventually corrected considering the temperature value) is maintained at a sufficient value, i.e. above the established threshold value defining the low limit of the correct inflating pressure of the tire, the device will remain loaded, i.e. with the lamina 18 bent down wards and the plunger 11 in its low limit stop; the same device will maintain the connection to the air tube through the self-closing valve core 7.

It is necessary to specify that the utility of the function attained by the device (i.e. signalling when the tire pressure falls bellow at least one pre-established threshold value) is relative to all normal working conditions, where the deflating of the tire takes place slowly, therefore, in a way difficult to perceive by means of common observation (phenomenon which takes place either be cause of natural causes, like an escape through the structure of the same tire, or because of external causes, like small punctures which cause a slow deflating); therefore, the device allows the duration needed for sensing the signal and operating as soon as possible in order to restore the most correct pressure value (and/or repair the eventual puncture for preventing the compulsory stop of the vehicle). Obviously, the device will not offer any practical utility in the case of punctures or other serious phenomena causing the deflating of the tire in such a quick way that the duration for sensing the signal and acting consequently is insufficient.

Naturally, the pre-established threshold value defining the low limit of the correct inflating pressure can be defined in such a way to assure that the signalling of the exceeding of the same threshold value occurs when the pressure value in the tire is still sufficiently high to allow the duration needed for sensing the signal and acting in the usual operating situations when the deflating takes place slowly.

When the pressure (eventually corrected considering the temperature value) falls below said pre-established threshold value (or below another threshold value lower than the previous), as shown in Fig.5, the lamina 18 will bend up wards. This bending will immediately enable the bistable valve 22 fitted with a double closing device to automatically commute from the first to the second position of stability for closing the connection between the duct 13 and the chambers 16 and 20 (through the channel 21 and the duct 12); vice versa the connection between the chamber 20 and the housing 17 (through the duct 12 and the channel 21) remains open. The housing 17, through the duct 14, is connected to the chamber 15 which, in its turn, is connected to the atmosphere 27 through the duct 28, the channel 29 and the groove 31.

The aim to be attained when this situation occurs is the safe closing of the tire; therefore, the tire is insulated from the environment by means of the self-closing valve core 7 for preventing any air escape through the valve core 7 or the device. For this purpose, the device is so planned that the downward thrust acting on the group of the plunger 11 because of the difference between the pressure in the upper chamber 20 (where the tube pressure exists) and the pressure in the lower chamber 15 (where the environmental pressure exists), when the difference in pressure between the chamber 20 and the housing 17 is capable of maintaining the lamina 18 bent downwards, is so high to widely exceed the upward thrust acting on the plunger 11; this thrust being caused by the valve core 7 stressed upwards by the spring 8, the air tube pressure acting on the rod section of the plunger 11 and the elasticity of the bellows 10. In this way, the plunger 11 is guaranteed to remain in the loading position (low limit stop) even in presence of external perturbations (vibrations, forces of inertia, etceteras).

The starting of the phenomenon which causes the unloading of the device is due to a change in the tire pressure (eventually corrected considering the temperature value) referred to the atmospheric pressure, said change being capable of bending the lamina 18 upwards, when the pressure in the cavities 17, 14, 15, 28 and 29 still presents the atmospheric value and the pressure in the cavities 16, 20, 12, 21, 13 and 26 presents the air tube value (which has just fallen below the established threshold). In these conditions, the difference between the pressure in the upper chamber 20 (where the tube pressure exists) and the pressure in the lower chamber 15 (where the environmental pressure exists) acting on the plunger 11 is anyway still capable of maintaining the plunger 11 in the loading position (i.e. in the low limit stop): in fact, the planning of the active sections of the plunger 11 and of the relative rod will be chosen in such way that the resultant vector of the various above listed forces acting on the plunger 11 will anyway be directed downwards also for tire pressure values lower than the pre-established threshold value, while, once above said threshold value, the lamina 18 will bend upwards. Since the de vice has been planned for a practical utility in all normal working conditions where the deflating of the tire takes place slowly, at the instant when the tire pressure (eventually corrected considering the temperature) passes to a value lower than the threshold pre-established for this purpose, the lamina 18 will bend immediately upwards, but the resultant of the forces act-

ing on the plunger 11 (the module of which will be changed in its turn, but only by a very small quantity the phenomenon being slow) will keep always directed down wards; furthermore, said resultant will present a value such as to permanently maintain the plunger 11 in the low limit stop, until the pressure in the upper chamber 20 falls considerably. This notable fall occurs as a direct immediate consequence of the upward bending of the lamina 18.

In fact, the motion towards the second position of stability of the valve 22 fitted with a double closing device consequent to the modification of the geometrical configuration of the lamina 18 causes a sudden change in the pressures within the various cavities. The jointing between the duct 13 (which remains at the tire pressure together with the chamber 26) and the chambers 16 and 20 (thorough the ducts 21 and 12) is disconnected, while the chambers 20 and 16 are emptied through the same ducts 12 and 21, the housing 17 (which now is connected to the channels 21 and 12), the duct 14, the chamber 15 and the channel 28, the groove 31 and the channel 29 which are directly connected to the atmosphere 27. In this way, the pressure in the chamber 20 quickly falls, while, because of the losses of pressure which hinder the air flow to the atmosphere 27 through the duct 28, the groove 31 and the channel 29, the pressure in the chamber 15 tends to increase (previously the pressure in the chamber 15 presented the atmospheric value). This phenomenon associated with the upward thrust acted on the rod of the plunger 11 by the self-closing valve core 7 stressed by the spring 8 and the bellows 10, causes the sudden upstroke of the plunger 11 towards its low limit stop.

As soon as the upstroke of the plunger 11 starts, the rod with two diameters disengages from the gasket 25: in this way a direct connection is suddenly created between the chamber 26, which until the self-closing valve core 7 closes, remains at the tire pressure and is potentially fed by an considerable air flow, and the chamber 15 located under the plunger 11. In this way, the pressure in the chamber 15 immediately reaches the tire pressure value by exerting an upward stress on the plunger 11; said pressure value is maintained until the self-closing valve core 7 completely closed by reaching the scope of the present invention, while the self-closing valve 23 prevents the air from flowing towards the housing 17, and from this one, through the ducts 21 and 12, the air can reach the chamber 20 situated over the plunger 11, where in the meantime the pressure has fallen with respect to the tire value presented before exceeding the threshold.

In this way, the plunger 11, until the self-closing valve core 7 is completely closed, will be subject to an upward resultant thrust , the resultant thrust being due to the difference between the pressure in the chambers 15 and 20 plus the thrust applied to the needle of the self-closing valve core 7 stressed by the spring 8 and the thrust of the bellows 10, the resultant thrust being sufficient to move the plunger 11 upwards, even if an identical pressure value should be found in the chambers 15 and 20. In fact, the pressure in the chamber 15 re mains at the tire value, since the outlet flow from the self-closing valve core 7 still open is much higher than the loss flowing towards the atmosphere through the duct 28, the groove 31 and the channel 29: this fact assures that, even if the pressure in the chamber 20 should fall by a small quantity, or, even, revert to the value of the air tube at the moment when the disengagement of the rod of the plunger 11 from the gasket 25 occurs, as it might occur if the self-closing valve 23 was removed, the resultant of the stresses acting on the plunger 11 would anyway be always directed upwards thanks to the elastic action of the spring 8 and the bellows 10.

This fact causes the sudden upstroke of the plunger towards its high limit stop and the closing of the self-closing valve core 7 by obtaining the desired result and the unloading of the device: when the self-closing valve core 7 closes, both chambers 20 and 15 are suddenly connected to environmental pressure (atmospheric pressure), while the plunger 11 completes its upstroke until it reaches the high limit stop thanks to the elasticity of the bellows 10 (Fig.6).

In this way, the tire is immediately insulated from the environment; therefore, the self-closing valve core 7 always performs its function of safety and closing against air escapes through the inflating valve. This fact prevents any risk due to eventual escapes in the device.

If the plunger 11, after the loading phase, remains in the position such as to keep the self-closing valve core 7 open, i.e. in its low limit stop, that means the pressure in the air tube (eventually corrected considering the temperature value) is higher than the pre-established threshold value defining the low limit of the correct inflating tire pressure; vice versa, when the plunger 11 moves back to the high limit stop (i.e. it unloads) the pressure in the air tube (eventually corrected considering the temperature value) is lower than said pre-established threshold value, or another pre-defined threshold value lower than the previous one.

It is, then, sufficient to sense either the bending of the lamina 18 or the position of the plunger 11 (the stroke of which is of some mm.) for signalling the exceeding or not of the threshold value to the external with known means, the threshold value defining the low limit of the correct tire pressure. For example, a chromatic variation in function of the position of the plunger 11 can be displayed on a transparent visor applied to the wall 2. In addition, the displacement of the plunger 11 (or the change in the geometrical configuration of the lamina 18) can set at work an electrical circuit by means of which the emission of optical and/or acoustic signals can be obtained, said signals being transmitted by induction, or hertzian waves etc. with all its possible combinations.

The device can obviously be reloaded indefinite times; all times the condition of exceeding the threshold value

will occur it will automatically unload and remain unloaded until subsequent hand loading by assuring that the signal can be received.

Fig.6 shows the device after the falling in the tire pressure; in this case, the components of the device are again in the position of Fig.2.

Claims

1. Device capable of signalling the inflating condition in the tires characterised by the fact that it comprises: an external envelope (1) rotating together with a threaded body (4) which can be screwed on a jointing tube (5) of an inflating valve (6) presenting a self-closing valve core (7) stressed by a spring (8); a plunger (11) which can be disposed in a first limit stop, the plunger (11) being used for maintaining the self-closing valve core (7) open by means of a rod having two sections with different external diameters if the difference between the tire pressure and the atmospheric pressure exceeds at least one pre-established threshold value; an element (18) with variable geometrical configuration which closes a housing (17), the geometrical configuration of the element (18) depending on the difference between the tire pressure and the atmospheric pressure, the element (18) presenting a first geometrical configuration when the atmospheric pressure acts on the housing (17) and the tire pressure is higher than the highest pre-established threshold value, and a second geometrical configuration when the tire pressure is below the lowest pre-established threshold value; a sealing member (10) separating a first chamber (15), defined under the plunger (11), from a second chamber (20) defined over the plunger (11); a duct (14) connects the housing (17) to the first chamber (15), which, in its turn, is connected to the atmosphere (27) through a duct (28), a channel (29) and a groove (31); a third chamber (26) is separated from the first chamber (15) when the plunger (11) is found in the first limit stop; ducts (12,13,21) and a bistable valve (22) fitted with a double closing device, acted by the element (18), for connecting said chamber (20) to the air tube, so that, when the element (18) is found in the first configuration, the valve (22) can reach the first position of stability and the plunger (11) can be found in the first limit stop, and, vice versa, for connecting said chambers (15,20) to each other, and for jointing said chambers (15,20) with the atmosphere (27) through the duct (28), the channel (29) and the groove (31) when the element (18) is found in the second configuration, and, consequently, the valve (22) reaches the second position of stability; when the tire pressure falls below the lowest pre-established threshold value, the element (18) immediately reaches the second configuration for allowing the bistable valve (22) fitted with a double closing device to reach the second position of stability and close the connection between the duct (13) and the chamber (20) through the channel (21) and duct (12) and to open the connection between the chamber (20) and the housing (17), in its turn jointed to the atmosphere (27), through said channel (21) and duct (12); in this condition, the plunger (11) always moves towards a second limit stop and, therefore, does not act on the self-closing valve core (7), which can maintain its function of preventing the air from escaping from the air tube, without introducing the risk of the tire pressure continuing to fall below the lowest threshold value when the same device presents an escape; the device further comprises means used for signalling if the tire pressure is correct or not.

2. Device as in claim 1, wherein the element (18) with variable geometrical configuration is a bistable lamina (18).

3. Device as in claim 2, wherein the element (18) with variable geometrical configuration is a bimetal (18) allowing to change the pressure threshold which causes the commutation of the bending in function of the temperature.

4. Device as in claim 1, wherein the deformable sealing member (10) consists of a bellows (10) jointing the threaded body (4) to the plunger (11); the bellows (10) allows the frictionless axial sliding of the plunger (11) inside the de vice and separates two chambers (15,20) which are respectively located under and over the plunger (11).

5. Device as in claim 1, wherein the upper part of the plunger (11) is held by the housing (17) closed by the element (18) with variable geometrical configuration; a gasket (19) assures the sealing between the inner part of the housing (17) and the chamber (20); a channel (21) connects the housing (17) to the internal ducts (12,13) of the plunger (11), and the element (18) with variable geometrical configuration (18) controls the channel (21) by acting on the bistable valve (22) fitted with a double closing device, said valve (22) presenting a first position of stability when a first section of the closing device of the valve (22) closes the connection between the housing (17) and the channel (21), while maintaining the connection between the duct (13) and the channel (21) open, and a second position of stability when a second section of the closing device of the valve (22) closes the connection between the duct (13) and the channel (21), while maintaining the connection between the housing (17) and the channel (21) open.

6. Device as in claims 1, 2 and 3 , wherein the element (18) with variable geometrical configuration reaches the second geometrical configuration when the pressure in the chamber (20) does not present a value sufficiently high with respect to the atmospheric pressure existing in the housing (17); the bending of the element (18) depending on the difference between the pressure in the chamber (20), connected to the air tube of the tire when the plunger (11) is found in the first limit stop, and the pressure in the housing (17) connected to the atmosphere; if this difference in pressure is sufficiently high, the element (18) reaches the first geometrical configuration with stability, vice versa the element (18) maintains its second geometrical configuration.

7. Device as in claim 1, wherein an external axial thrust (P) causes the axial motion of the external envelope (1) with respect to the threaded body (4) by exceeding the thrust of the spring (9); the thrust (P) on the external body of the device (external envelope 1, wall 2) causes the change in the geometrical configuration of the element (18) and the motion of the plunger (11) towards the first limit stop, as it might occur, if the pressure in the chamber (20) was sufficiently higher than the pressure in the housing (17) and the chamber (15); in this phase the bending of the element (18) and the motion of the plunger (11) towards the first limit stop occur only because of the mechanical thrust (P).

8. Device as in claims 1 and 7, wherein, after the releasing of the thrust (P), the spring (9) and the air pressure acting in the chamber (20) move the external envelope (1) back to its original stable limit stop; if the tire air pressure existing in the chamber (20) is capable of exerting a stress on the element (18), the stress being sufficient to maintain the element (18) in the first geometrical configuration, said stress also holds the plunger (11) fasten in the first limit stop so that the rod of the plunger (11) can maintain the self-closing valve core (7) open for assuring the continuous connection between the air tube and the element (18) through the chamber (26), and the cavities (12,13,20,21), where the tube pressure exists; therefore, as long as tire pressure maintains a sufficient value, i.e. above at least one pre-established threshold value, the device remains loaded, i.e. with the element (18) in its first geometrical configuration and with the plunger (11) in the first limit stop for maintaining the connection with the air tube of the tire through the self-closing valve core (7).

9. Device as in claim 1, wherein the position of the plunger (11) signals the exceeding or not of at least a pre-established threshold value; for this purpose a transparent visor applied to the wall (2) is used for displaying a chromatic change in function of the position of the plunger (11).

10. Device as in claim 9, wherein the displacement of the plunger (11) or the change in geometrical configuration of the element (18) sets at work an electrical circuit by means of which the emission of optical and/or acoustic signals can be obtained to be transmitted via hertzian waves.

Fig.1

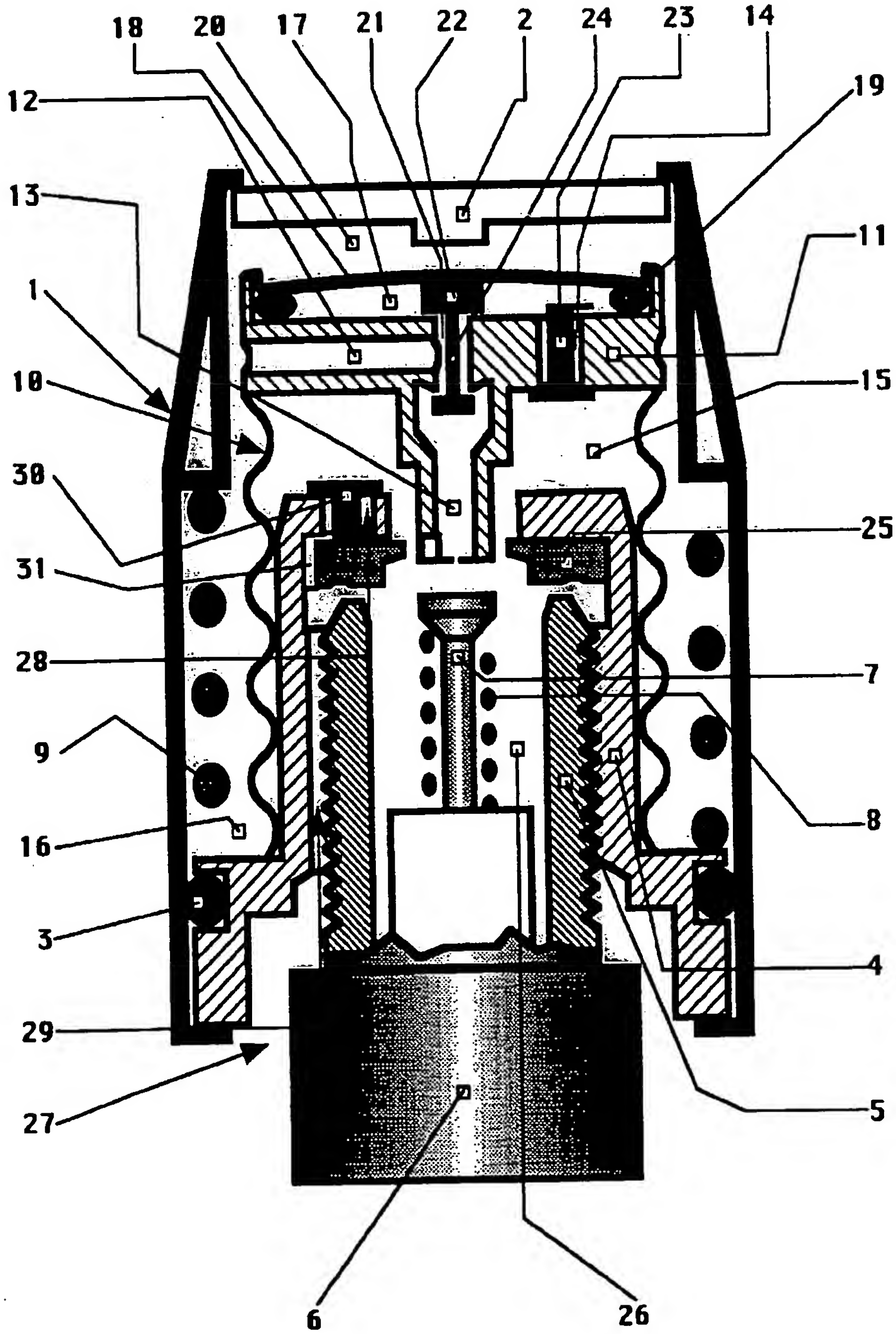

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Fig.2

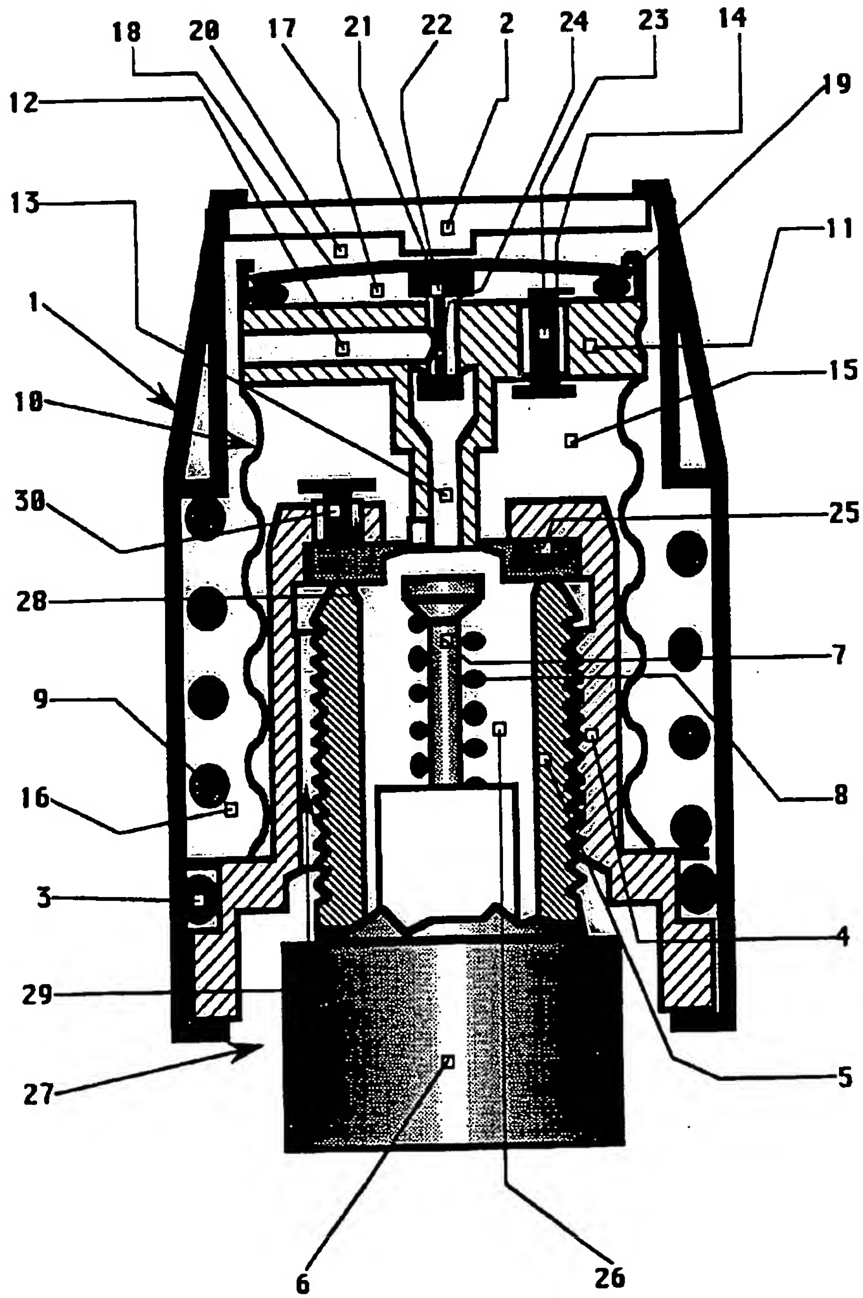
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Fig.3

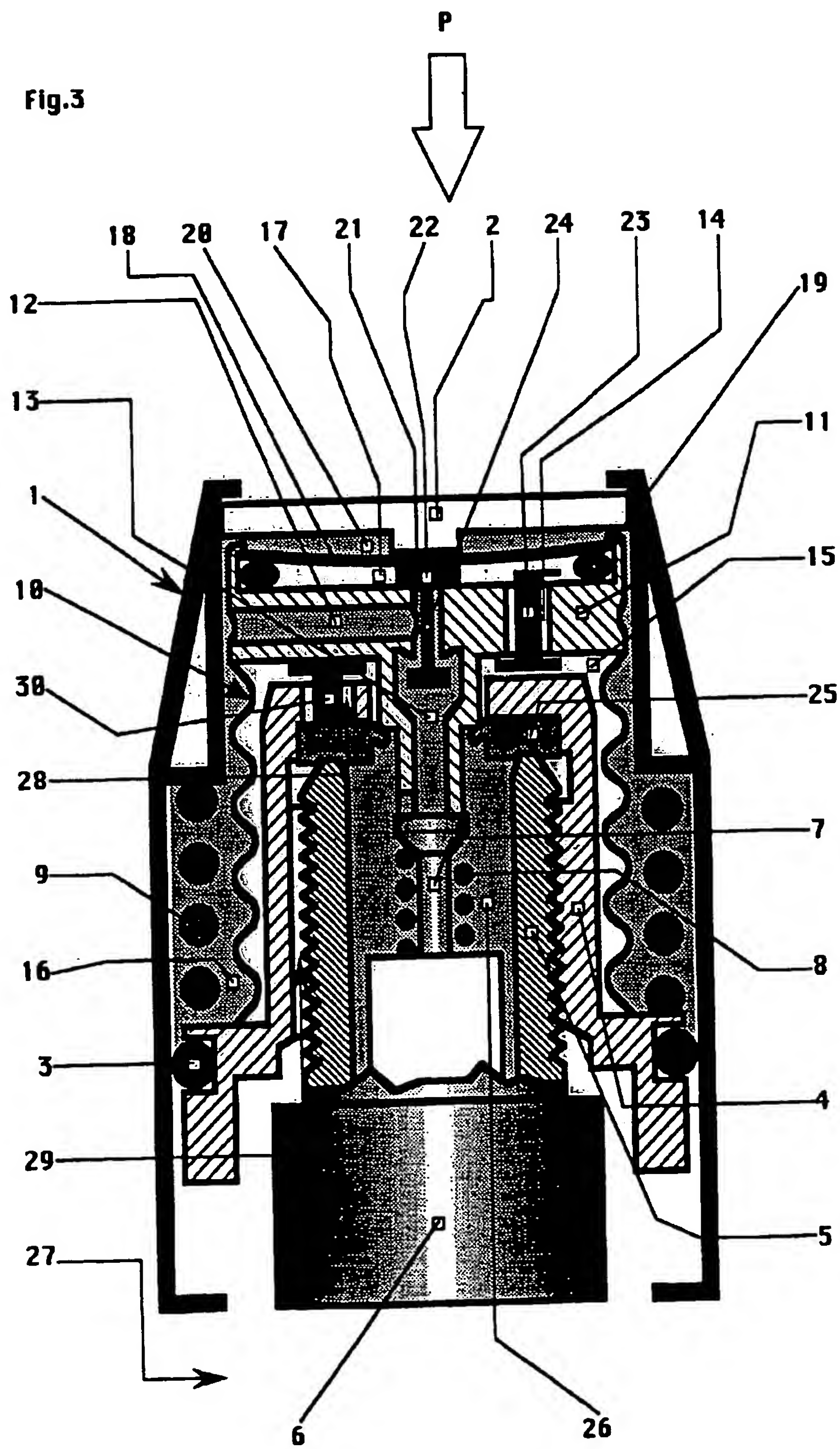
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Fig.4

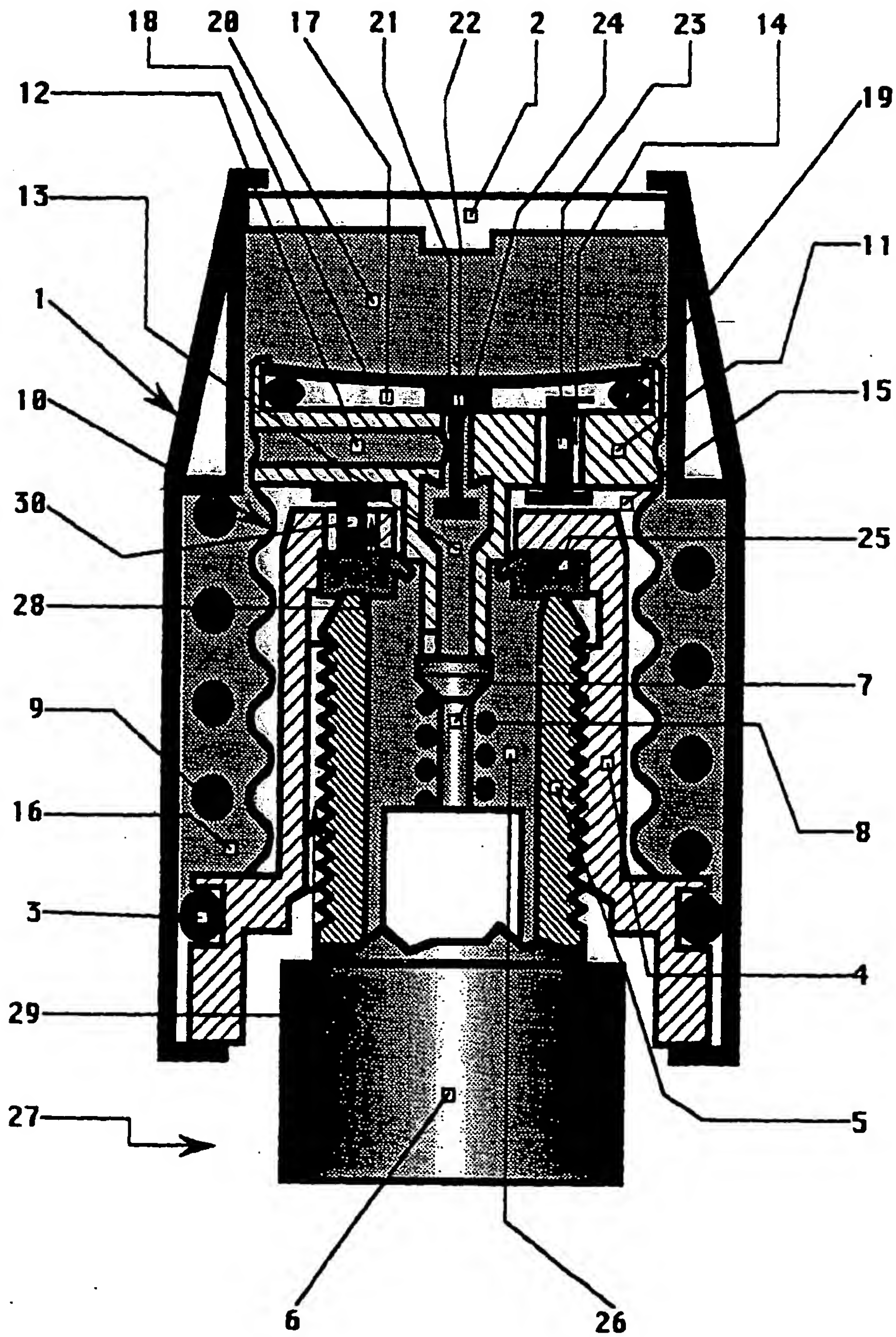
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Fig.5

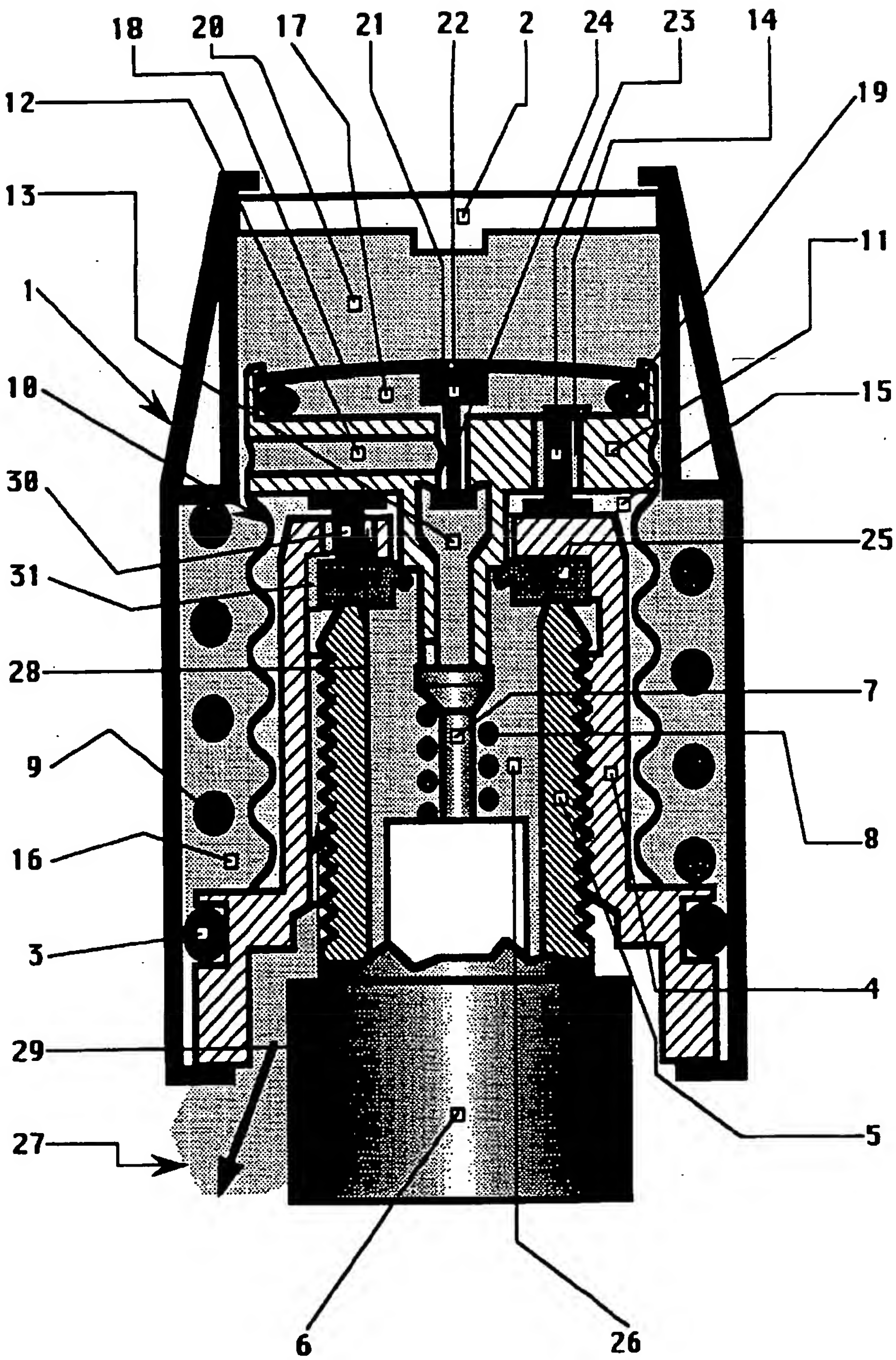
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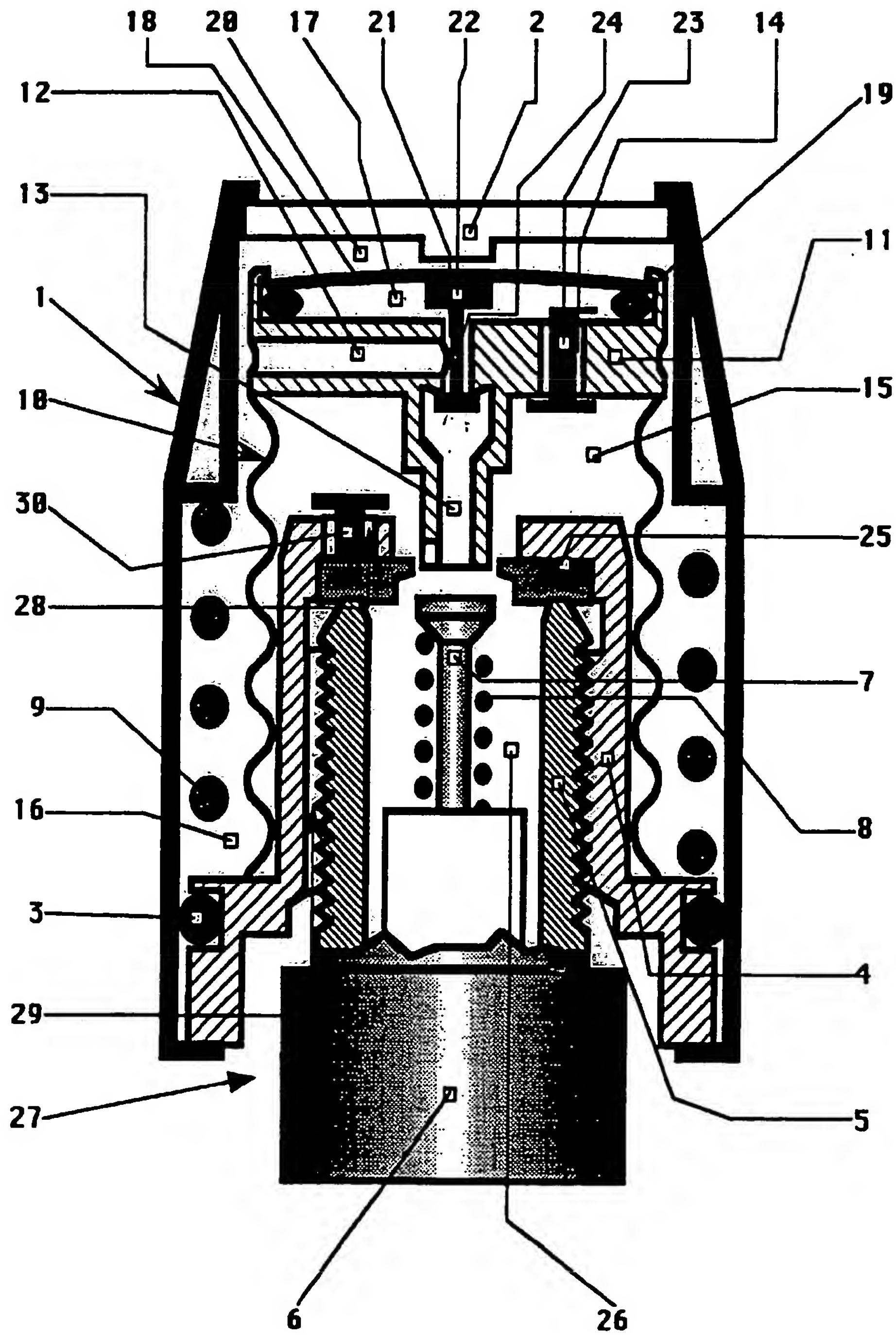
Fig.6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EUROPEAN SEARCH REPORT

Application Number
EP 98 10 9696

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 3 451 418 A (NAKAGAWA SHUNSHI ET AL) 24 June 1969 * column 5, line 1 - line 21; figure 2 *	1,4,7,8	B60C23/00 B60C23/04
Y		2	
Y	US 2 866 432 A (LAURIE) 30 December 1958 * column 3, line 56 - column 4, line 10; figures *	2	
A	US 5 325 808 A (BERNOUDY JR DAVID A) 5 July 1994 * column 4, line 23 - column 5, line 12; figures 2,6 *	1	
A	US 2 906 282 A (SHANNON) 29 September 1959 * column 3, line 30 - line 48; figures *	1,9	
A	US 4 335 283 A (MIGRIN ROBERT S) 15 June 1982 * column 5, line 40 - column 7, line 5; figures *	2,3	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	EP 0 351 997 A (LIQUID LEVERS LTD) 24 January 1990 * column 5, line 7 - line 17; figures 4,5 *	3	B60C
A	DE 43 32 717 A (VDO SCHINDLING) 9 June 1994 * abstract; figures *	2,3	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	30 October 1998	Hageman, L

CATEGORY OF CITED DOCUMENTS

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